What makes people leave their food? The interaction of personal and situational factors leading to plate leftovers in canteens

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I Thematic Background

Sustainability in food production and consumption has gained substantial attention in international politics and research (see e.g. the UN sustainable development goals set up in September 2015). Within this context, the reduction of food losses along the food supply chain is declared a specific target (FAO, 2013). In 2015, the European Commission estimated an annual food waste of 100 million tons in EU member states of which more than 40 % occur at retail and consumer level. Relating to the trend of increased out-of-home consumption of food, the Commission named „standardised portion sizes in restaurants and canteens" as one of the factors that contribute to avoidable food waste (European Union, 2016). This can be supported by estimates in Finland (Katajajuuri, Silvennoinen, Hartikainen, Heikkilä, & Reinikainen, 2014), Sweden (Engström & Carlsson-Kanyama, 2004) and Germany (Kranert et al., 2012), where the food service sector and explicitly plate leftovers at the guest level are identified as relevant sources of avoidable food waste. Considering research on food-related behavior in general, the emphasis on portion sizes as single factor for food leftovers in out-of-home catering appears too simplistic. Various studies indicate that food choice and eating behavior in out-of-home consumption settings relate to a wide set of personal, social and situational factors such as food-related values (Lusk & Briggeman, 2009), attitudes (Sparks, Hedderley, & Shepherd, 1992), social norms (Cruwys, Bevelander, & Hermans, 2015), personal comfort (Byker, Farris, Marcenelle, Davis, & Serrano, 2014) and choice design (a. S. Hanks, Just, Smith, & Wansink, 2012). Moreover, studies that have specifically considered plate leftovers, mainly to determine consumption of specific food types (e.g. fruit and vegetables), support an extended behavioral framework in order to understand what makes people leave their food on the plate (Lowe et al., 2010; Wrap, 2011).

There are only few studies that have applied the comprehensive behavioral model needed (Finkbeiner, 2013; Mahon, Cowan, & McCarthy, 2006). One limitation of those existing studies is that food leftovers are either measured in an aggregate form and by individuals'

stated behavior. Accordingly, the aim of the paper is to test an extended behavioral framework concerning the relevance of determinants related to food choice and eating on plate leftovers in the out-of-home setting of canteens, with plate leftovers being measured by visual estimation. Based on an extended literature review, structural hypotheses are derived considering three dimensions of influencing factors as: (physical) environment, social contexts and personal behavioral determinants. In order to empirically test the hypotheses-based structural model, an estimation is carried out for a dataset of observational and survey data, collected among 343 students in a university canteen. Finally, we relate our results to past studies in the research area and draw conclusions on the interaction of environmental, social and personal determinants for the presence of food leftovers in catering.

II Derivation of Research Hypotheses

In line with the research objective, studies on food-related behaviors in out-of-home settings which mostly have focused on specific determinants for food-related behaviors are analyzed. By linking findings for personal, social and environmental factors, research hypotheses are derived and at the end of this section, are translated into a structural model.

II.1 Personal Determinants of Food Leftovers

A prominent research area with respect to consumer behavior in catering facilities are the personal determinants of food choice and consumption from a health perspective (Nordström & Thunström, 2015; Scholderer, Kügeler, Olsen, & Verbeke, 2013; Schulte-Mecklenbeck, Sohn, Bellis, Martin, & Hertwig, 2013). Generally, the TPB is an extensively applied model for individual health- and food related behaviors (Harland, Staats, & Wllke, 1999; Tonglet, Phillips, & Read, 2004). It states that behavior can be determined by measuring behavioral intention (Ajzen, 1991). Behavioral intention itself is influenced by three constructs: first by attitudes towards the behavior; second by perceived social norms (subjective norms) or the evaluation of relevant others with respect to the behavior; and third by perceived behavioral

control over the behavior (Ajzen & Fishbein, 2005; Ajzen, 1991). With respect to the application of the TPB for sustainable consumer behaviors, such as organic food purchasing (Arvola et al., 2008; Tarkiainen & Sundqvist, 2005), healthy food consumption habits (Cook, Kerr, & Moore, 2002; Mahon et al., 2006; Sparks et al., 1992), as well as waste recycling behavior (Barr, 2007; Graham-Rowe, Jessop, & Sparks, 2014), it has partially been suggested to add personal norms as a fourth construct to determine behavioral intention. This construct measures a normative evaluation of the behavior based on personal value systems. Personal norms have been found to have a direct influence on behavioral intention as well as an indirect effect from their influence on attitudes (Arvola et al., 2008; Harland et al., 1999). Moreover, personal norms have been shown to be interrelated with subjective norms (Aertsens, Verbeke, Mondelaers, & Huylenbroeck, 2009; Arvola et al., 2008). Accordingly, three hypotheses are formulated for the behavioral determinants of plate leftovers in a university cafeteria.

H1: Food leftovers at lunch are negatively influenced by the behavioral intention to finish all food on one's plate in the university cafeteria.

H2: The behavioral intention to finish all food at lunch is positively determined by…

(a) …a positive attitude towards finishing all food at lunch in the university cafeteria.

(b) …high perceived personal control over finishing all food at lunch in the university cafeteria.

(c) …subjective norms which support the finishing of food in the university cafeteria.

H3: Personal norms in favor of finishing all food at lunch in the university cafeteria are…

(a) …positively correlated with subjective norms that support finishing food.

(b) …a positive determinant of positive attitude towards finishing all food at lunch.

II.2 Social Influences on Food Leftovers

Interrelated with personal determinants of food leftovers, food-related behavior in general has been stated to be influenced by social context (Cruwys et al., 2015; King, Weber, Meiselman, & Lv, 2004; Story, Kaphingst, Robinson-O'brien, & Glanz, 2008). One aspect of social influences is already considered in the TPB (see Chapter II.1, hypotheses H2(c) and H3(a)). Based on an extended review on food-related behaviors, Cruwys et al. (2015) conclude that social influences go beyond this dimension and also include seeking affiliation with others. Moreover, besides having an indirect influence on behavior via behavioral intention, social context and specifically the presence and behavior of other persons has been found to influence food choice and eating behavior directly and partly unconsciously (Cruwys et al., 2015; Mollen, Rimal, Ruiter, & Kok, 2013). Young et al. (2009) show that the presence of others tends to decrease food intake of females in a university cafeteria setting. Hence, we assume:

H4: Plate leftovers at lunch in the university cafeteria are positively influenced by the presence of other persons during lunch.

II.3 Environmental Determinants of Food Leftovers

Besides personal and social determinants of food-related behavior, a growing literature body deals with the impact of environmental or situational factors on food choice and eating in catering and the respective impacts on nutritional meal quality and food leftovers (Hanks, Just, Smith, & Wansink, 2012; Thiagarajah & Getty, 2013; Wansink, 2004). Within these studies, palatability of food and portion sizes are prominent areas of research. Related to palatability, various studies state that the palatability of food (visual appearance, smell and taste of food) is one of the greatest drivers of food-related behaviors (Eertmans, 2006; Pliner & Mann, 2004; Tuomisto, Tuomisto, Hetherington, & Lappalainen, 1998). Accordingly, low ratings of palatability have been found to be a major stated reason for food leftovers (Betz,

Buchli, Göbel, & Müller, 2015; Goebel et al., 2014). Different studies that aimed to increase fruit and vegetable consumption (and to decrease plate waste of fruit and vegetables) in out-of-home settings have focused on palatability as measure of successful behavioral change (Brug, Tak, te Velde, Bere, & de Bourdeaudhuij, 2008; Cooke et al., 2011). Portion sizes as second relevant topic have as well been found to determine food consumption and food leftovers in various settings (Dinis, Martins, & Rocha, 2013; Marjorie R Freedman & Brochado, 2010; Hermans, Larsen, Peter Herman, & Engels, 2012). Thereby, bigger portion sizes have been related to unconsciously increased food consumption but as well to increased plate leftovers and food waste with the latter being nearly proportional to the initial amount of food on a plate (Wansink & Van Ittersum, 2013). Besides, the perceived portion size of food has been analyzed as relevant explanation for food leftovers by catering guests (Betz et al., 2015). Accordingly, the situational perceived portions size and the perceived palatability of food at a specific day are hypothesized to take a direct influence on plate leftovers.

H5: Food leftovers at lunch are positively related to perceived larger portion sizes of food.

H6: Food leftovers at lunch are negatively related to a higher stated palatability of food.

Additionally to the direct impacts of situational portion size and palatability on plate leftovers, research implies that the formation of behavioral determinants generally is based on experiences that may be related to environmental variables (Ajzen, 2001). Therefore, two additional links and indirect influences of palatability and portion size via behavioral variables will be considered in our model. In line with studies finding that people cognitively justify plate leftovers regularly with large portion sizes or unfavorable taste in catering (Betz et al., 2015), we consider two relationships in our model. First the determination of attitudes towards leftovers by palatability going along with palatability as one dimension of food related attitudes and accordingly of the eating and leftover behavior (Roininen, 2001).

Second, we regard portion sizes as an externally caused reason for food leftovers and thus consider the presence of this justification as a specific determinant of perceived behavioral control (Ajzen, 1991).

H7: Higher palatability of food in the university cafeteria creates more positive attitudes towards finishing all food.

H8: Larger portion sizes create lower ratings of perceived behavioral control.

Additional aspects have been identified to influence consumers' food valuation and plate leftovers (e.g. Lusk & Briggeman, 2009). In this respect, the type of food chosen is likely of relevance for consumers' evaluation of palatability. According to previous studies food leftovers are not equally distributed over all food components potentially making the choice of food also a direct factor of food leftovers (Betz et al., 2015; Ferreira, Martins, & Rocha, 2013). This leads to the following hypotheses:

H9: Specific types of food choice in the university cafeteria…

(a) …create higher ratings of palatability than other choice types.

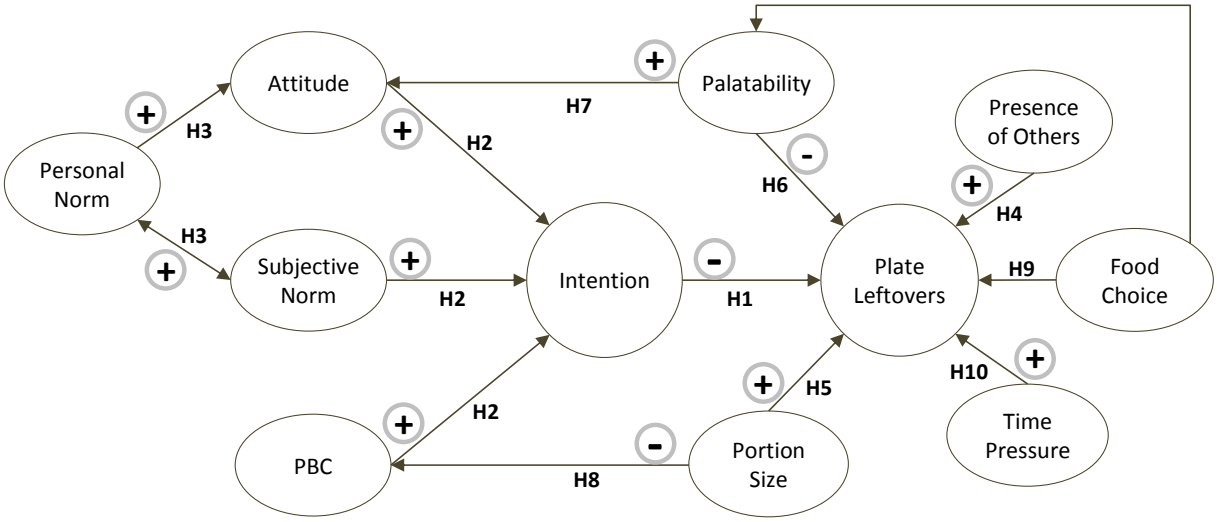
(b) ...create higher amounts of plate waste, independently from their effect on palatability.

Finally, time pressure may, independently from other determinants, provide a causal reason for plate leftovers as past research has shown that an extended time for a meal is related to higher food intake and lower plate leftovers (Entrée et al., 2015; Price & Just, 2014; Wansink, 2004).

H10: Time pressure during lunch increases plate leftovers.

Overall, the derived research hypotheses lead to a structural framework consisting of 11 variables (see Figure 1).

Figure 1. Structural model for food leftover behavior



Source: own illustration

III Methodology

Based on the theoretical structural model, the methodology section displays the variables and indicators based on which an empirical measurement was conducted. Moreover, the collection of data and analyses prior to the final estimation of structural relationships are presented.

III.1 Definition of Measurement Systems

To test the theoretical model derived in section II, six of the structural variables (Figure 1) were set up in the form of multidimensional latent constructs (personal norm, attitude, subjective norm, perceived behavioral control, intention and palatability). With reference to past consumer studies, those constructs were defined by measurement systems of three variables each (see Table 1). The remaining environmental variables were directly measured by sets of dummy variables (types of food choice and presence of others) or in continuous form (portions size and time pressure) as displayed in Table 1. The latter also holds for the dependent variable (plate leftovers).

Table 1. Measurement of behavioral and environmental variables

Construct	Items	Reference
Attitude	Having leftovers is bad/good*[reversed measurement]	Crites, Fabrigar, & Petty, 1994
	Having leftovers makes me feel satisfied/ unsatisfied*	
	Having leftovers makes me feel happy / unhappy*	
Subjective Norm	Others finish all food on their plate x I try to do the same*	Cialdini, Kallgren, & Reno, 1991; Cruwys et al., 2015
	Others think people should finish all food x Their opinion is important to me*	
	Others may criticize me if I don't finish all food x Their critics make me feel uncomfortable*	
Perceived Behavioral Control	Predicting food amount at food choice is easy*	Armitage & Conner, 2001
	Finishing all food on my plate is usually easy to me*	
	I could always finish all food on my plate if I wanted to*	
Intention	I will do my best to empty my plate*	Ajzen, 2006
	I somewhat expect to have leftovers* [reversed measurement]	
	I generally try not to leave food*	
Personal Norms	I am not the type of person to leave food on my plate*	Cook et al., 2002
	Leaving food on your plate is wrong*	
	I don't think that it makes any difference whether I finish all food on my plate or not* [reversed measurement]	
Palatability	Visual appearance of food today (1 to 5 stars)	Finkbeiner, 2013; Hermans, Larsen, Peter Herman, & Engels, 2012
	Taste of food today (1 to 5 stars)	
	Smell of food today (1 to 5 stars)	
Portion Size	The portion size of my food today was too small / too large (7-point bipolar)	
Time Pressure	My lunchtime today was unusually short / unusually long (7-point bipolar scale)	
Plate Leftovers	Index for visually estimated leftovers per food component: 0 = no leftover, 1 = leftover < 0.5 portions, 2 = leftover of about 0.5 portions; 3 = leftover of more than 0.5 portions	Connors & Rozell, 2004
Food Choice	Stated food choice from a list of all available food offers at the day of survey participation, creation of three dummy variables: vegetarian vs. meat, salad bar vs. service line, special dish with fixed components and special name against regular dishes with variable component-based selection	
Presence of Others	Stated presence of other persons during lunch: creation of two dummy variables based on groups: eating alone, eating with one other person, eating with two or more other persons	
*measurement on five-point Likert Scale		

III.2 Collection and Clearing of Data

Data collection was carried out during one week in December 2015 at a university canteen in Germany. Thereby, visual measurement of individual plate leftovers via photographs was matched with an online (smartphone optimized) questionnaire. Besides to the indicators displayed in Table 1, the questionnaire composed of queries related to personal determinants of food choice and eating, specific perceptions of food related to the day of participation and

sociodemographic characteristics. Respondents were recruited in the cafeteria at the point of tray return. Guests who were interested in participating in, as told to them, "a general survey on having food in the university canteen" received an individualized card with an online link and QR code transferring them to the survey. Moreover, a picture of each participant's tray with the individualized card was taken before the guests returned their tray to the canteen staff (see Figure 2[1]). In order to estimate plate leftovers, leftovers of each food component were rated by two independent coders according to the four-point-scale of Connors & Rozell (2004) (see Table 1).

Figure 2. Exemplary photographs of observed food leftovers

Overall, 825 pictures were taken during three days, of which 383 successfully could be matched to a completed online survey questionnaire. The valid sample consisted of 343 participants who met two criteria: (1) they were all guests with student status (compared to university employee or guest status), serving as a proxy for a group of sociodemographic characteristics and comparable lifestyles and (2) had no missing answers in the directly measured indicators. While the former criteria led to an exclusion of 35, the latter implied an exclusion of five initial participants.

III.3 Exploratory and Confirmatory Factor Analysis

Preceding the structural model estimation, exploratory and confirmatory factor analyses (EFA/CFA) were conducted to test for the validity of the defined measurement systems. As

[1] Original photographs in color and high resolution.

the indicators of personal norms were highly correlated with indicators from attitude, subjective norms, perceived behavioral control and intention the construct personal norms had to be excluded from the subsequent analysis. For the remaining five latent constructs, results of the confirmatory factor analysis revealed sufficient factor loadings (standardized loading between 0.5 and 0.95) and sufficient composite reliability above 0.6 for all constructs besides intention (reference values from Bagozzi & Yi, 1988). In order to overcome the latter shortcoming, a two-indicator measurement was defined for intention, excluding the indicator "I somewhat expect to have leftovers". Results for the adjusted CFA are displayed in Appendix 1. Regarding discriminant validity, a comparison of correlation between latent constructs and their AVE revealed sufficient differentiation between the constructs according to Fornell & Larcker (1981) (see Appendix 1).

III.4 Model Estimation

A standard estimation method for CFA and corresponding structural equation models is Maximum Likelihood estimation (Brown, 2006). However, our data violated the condition of normal distribution for measured variables with moderate skewness (<2) and kurtosis (<7) (see Appendix 2). A model estimation via distribution-free Generalized Least Squares under mean-imputation for missing values indicated comparable estimation results to the Maximum Likelihood estimates regarding overall model fit, factor loadings and regression weights. Accordingly, it was decided to apply Full Information Maximum Likelihood due to the usage of a higher share of data provided by the dataset.

IV Results

IV.1 Sample Properties

Since the final sample of 343 participants only composed of student guests in a university cafeteria, it provides a relatively homogeneous group with respect to sociodemographic characteristics (see Table 2).

Table 2. Sample Properties for 343 students.

Characteristic	Sample Distribution (N=343)
Gender	female (48%), male (52%)
Age	<=18years (10%), 19-23 years (55%), 24-28 years (21%), >28 years (14%)
Faculty of enrollment	Mathematics and Natural Sciences (56%), Agriculture (29%), Medicine (10%)
University degree	no degree yet (63%), Bachelor, Diploma or Master (33%), Doctoral degree (2%), other (3%)
Household size	one person (35%), two persons (28%), three persons (14%)
Household composition	no children (90%), one child (7%), two or more children (3%)
Relationship status	single (61%), in permanent relationship (34%), married (4%)
Monthly net income	below EUR 900 (60%), EUR900 to EUR1300 (13%), EUR 1300 to EUR 2600 (14%), above EUR 2600 (13%)

On average, participants were 22.8 years with 80 % of the sample in the age range between 18 and 27. Two thirds of the sample did not hold a university degree yet, the other third either held a Bachelor, Diploma or Master Degree. As expected, the income situation was relatively homogeneous with 73 % stating a monthly net income below EUR 1300 and 13 % declaring a monthly net income of EUR 1300 to EUR 1600. Compared to general statistics (*national averages) on students in Germany, this sample may be regarded representative concerning average age (*24 years), gender (*48 % female), and monthly net income (*864 EUR). Participants of this study were more often single than the German average (*43%) and had more often children (*5 %) (Middendorff, Apolinarski, Poskwsky, Kandulla, & Netz, 2013). Moreover, the sample is biased towards students in subjects from the stated faculties which represent smaller shares of students on a national level (*mathematic and natural sciences, including agricultural sciences 20 %; medical sciences 6 %).

IV.2 Descriptive findings

With respect to the observed behavior and directly measured environmental determinants in our model, 258 participants (75 %) did not have considerable plate leftovers against 57 (17 %) participants with moderate (maximum 0.5 servings of one meal component) and 28 participants (8 %) with considerable plate leftovers (more than 0.5 servings of one meal component). Most of our participants went to lunch with more than one other person (68 %) or with one other person (24 %) against 8 % having lunch on their own. Regarding the

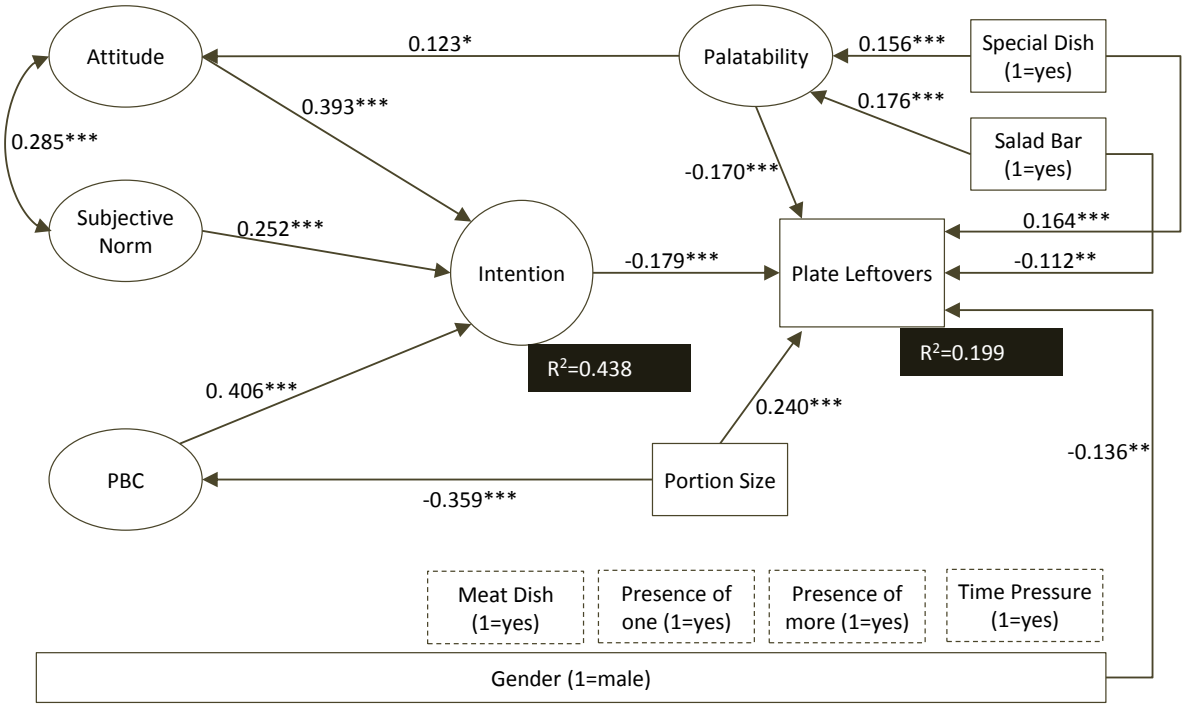
dummy variables for the type of food choice, most participants chose a meal from the regular service line (91 %) compared to the salad buffet (9 %). Meat or fish were a component in 60 % of food choices compared to 40 % of vegetarian lunches (including salad bar dishes). 13 % of food choices referred to special dishes that were served as a fixed composition of components and specially named, compared to 87 % regular dishes (including salad bar dishes). Considering finally the rating of portion sizes, about half of our sample (53 %) rated their portion size as adequate (central answer on the bipolar scale from 1 = too small to 7 = too big), while 32 % of participants rated the portion sizes as rather too small and 15 % as rather too big. Regarding the distribution of indicators for the latent variables, descriptive statistics are provided in Appendix 2.

IV.3 Structural Model for Food Leftovers

Based on the refined measurement systems from the CFA (Chapter III.3.), a structural model was estimated. Dummy variables for specific types of food choices (see Table 1) and for the presence of others during lunch (see Table 1) were tested separately as well as interactively in their impact on intention and leftover behavior. Moreover, dummy variables were included for sociodemographic features (gender, monthly net income and age by split half method), however, since only gender had a significant impact on any other variable in our model, only this sociodemographic characteristic was considered in the subsequent analyses.

Overall, the final structural model (8 independent variables, 5 dependent variables) reached a good fit to the empirical data with a minimum Chi-Square discrepancy CMin=300.05 under 192 degrees of freedom (CMin/df=1.56), a Comparative Fit Index (CFI)=0.923, a Tucker Lewis Index (TLI)=0.909 and a Root Mean Square Error of Approximation (RMSEA=0.041) (for reference values see Bagozzi & Yi, 1988; Brown, 2006). Estimation results for the regression weights and correlations on structural level are displayed in Figure 2.

Figure 2. Estimation results for the structural model (N=343)



Standardized estimates (only significant at α=*0.1, **0.05, ***0.01)

With respect to the theoretically derived determinants, the estimated model supports most assumed structural relationships and some dummy-variable impacts at significance levels of $\alpha<0.05$. The hypotheses related to personal norms **(H3a and H3b)** could not be tested as this latent construct had to be excluded from the structural model (as discussed above). Regarding the hypotheses linked to the behavioral constructs, the general impact of behavioral intention on leftover behavior **(H1)** as well as the impact of attitudes **(H2a),** subjective norms **(H2b)** and perceived behavioral control **(H2c)** on behavioral intention are supported by the estimates (see Figure 2). It is notable that the relative impact of perceived behavioral control and attitudes on intention is greater than the impact of subjective norms. Overall, the model reaches a sufficient R^2 of 0.438 for intention and an R^2 of 0.199 for the plate leftover behavior. Generally and independently from the structural model, male participants had lower leftovers than female participants.

Regarding the hypotheses on environmental variables, the assumed relationships between the presence of others and food leftovers **(H4)** cannot be supported since both dummy variables

contribute insignificant estimation results. In contrast to this, the assumed relationships between perceptions of food in form of portions size **(H5)** and palatability **(H6)** and food leftovers are substantiated by our empirical analysis. The same applies to the impacts from these two environmental variables on specific behavioral constructs: palatability of food positively influences stated attitudes towards finishing all food **(H8)** and larger perception of portion sizes decrease the perception of personal control over leftovers **(H7)**. Regarding the dummy variables on different types of food choice **(H9)**, 'choosing a special dish with fixed components versus a regular component-based choice' and 'choosing food from the salad bar versus food from the regular service line' both have a significant positive impact on taste (see Figure 2). Whereas the indirect influence on leftovers of choosing from the salad bar is supported by an additional direct negative impact on leftovers, a twofold perspective is observed in the model for choosing a special dish: in contrast to the negative indirect impact from improved taste, it also has a direct positive impact on the amount of food leftovers (see Figure 2). Finally, time pressure as environmental determinant of leftovers **(H10)** is not supported by the model estimates.

In contrast to our results, time pressure, has been highlighted in its relevance for plate leftovers (Entrée et al., 2015; Friese, Hofmann, & Wänke, 2008). In line with Scheibehenne, Miesler, & Todd (2007), we assumed that time pressure may not only be a direct determinant for food leftovers. Instead, it may shift the relevance of determinants for behavior from personal to environmental cues. Hence, time pressure was considered not only as direct influence on plate leftovers but also as contextual determinant of the relative impact of environmental versus personal behavioral determinants.

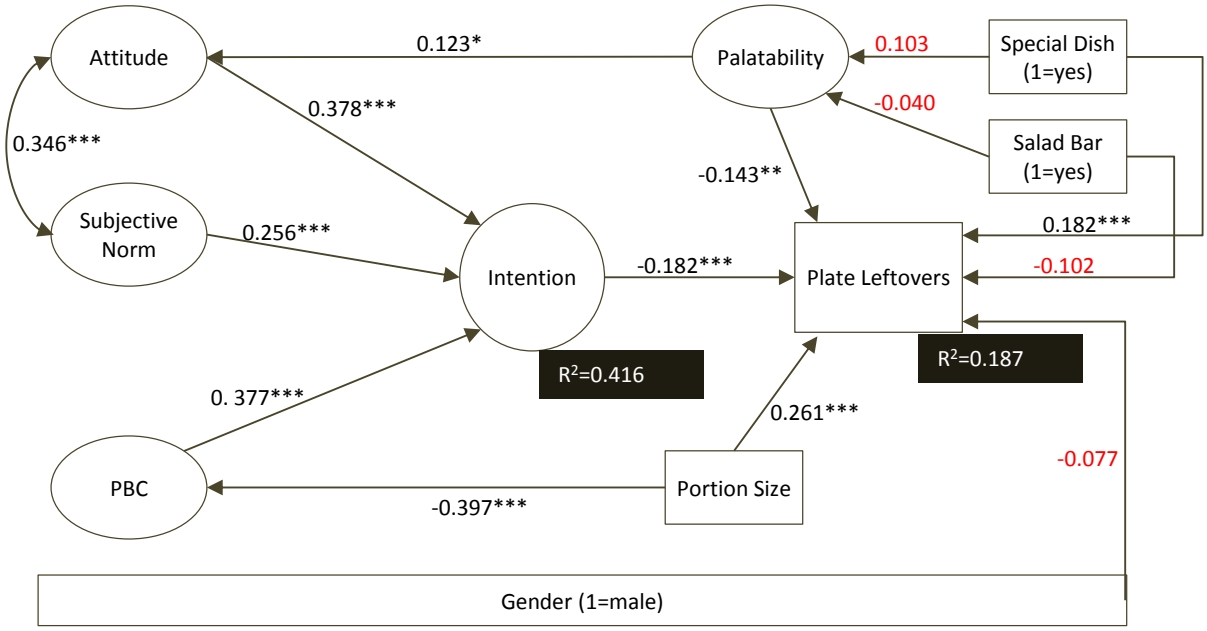
H10: Time pressure during lunch…

(a) …increases plate leftovers.

(b) …increases the relevance of environmental variables and decreases the relevance of behavioral determinants on plate leftovers.

Thereby, hypothesis 10a was already negated by the estimates of the general structural model. To additionally test hypotheses 10b, the model estimation was repeated under application of a grouping according to the dummy variable for time pressure taking the value of one if participants rated their lunchtime with 1 to 3 on a seven-point bipolar scale from 1=unusually short to 7=unusually long (N=105) and one model for the remaining participants N=238). Thereby, those situational variables that had no significant impact in the general model (meat versus vegetarian food choice, presence of others) were excluded from the subsequent analysis. Compared to the general model (Figure 2) the grouped model (figures 3 and 4) reveals an improved CMin/df of 406.10/297= 1.37 but also a slightly lower CFI (0.922) and TLI (0.913) and a slightly higher RMSEA of 0.046. Both groups contribute to a similar extent to the CMin value of the model with 188.48 (time pressure) and 217.62 (no time pressure) respectively. The estimated structural relationships in the two models however differ with respect to their strength and significance diminishing behavioral constructs' impact against environmental variables and thus are in line with the theoretical assumptions of time pressure (see Figure 3 and Figure 4).

Figure 3. Estimation results for group with regular or extended lunch time (N=238)



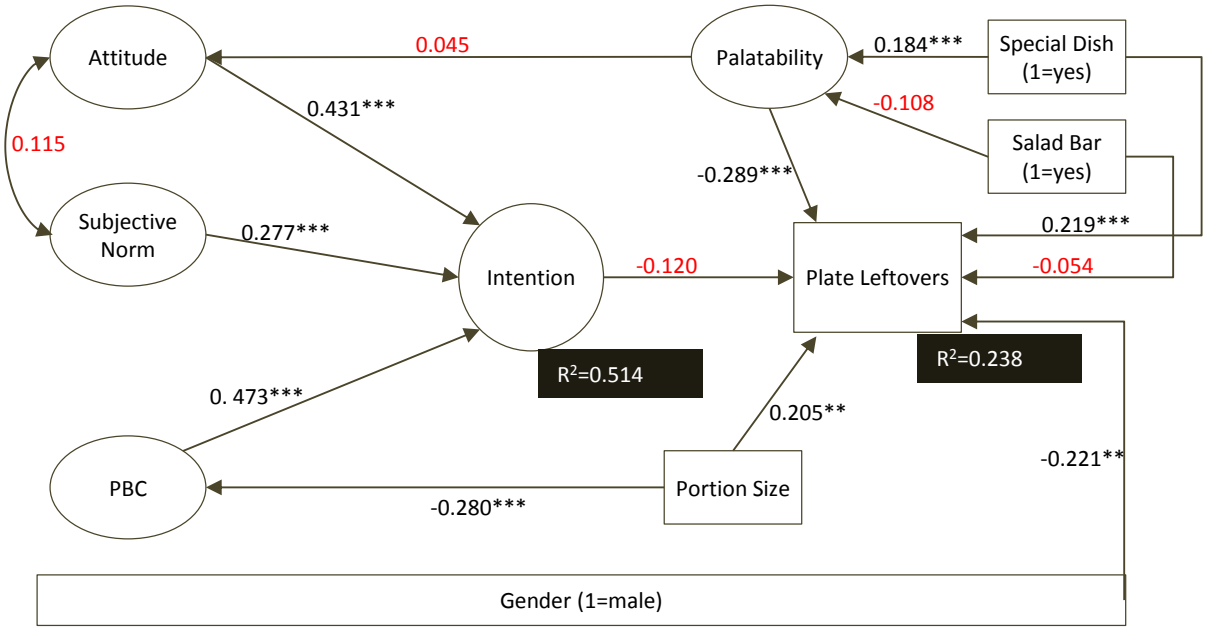
Standardized estimates (only significant at α=*0.1, **0.05, ***0.01)

Estimates for participants without time pressure (Figure 3) remain similar to the results for the general model with significant impacts of behavioral determinants, significant impacts of environmental variables and significant interactions of both, expect for the impact of food choice type on palatability (resolving the mentioned inconsistent impact of palatability on plate leftovers in the general model). Moreover, gender is insignificant in the model. Also the share of explained variances in intention and plate leftovers remains similar to the general model.

Parts of the model change when only people under time pressure (N=105) are considered. Whereas structural relationships within the behavioral part of the model (attitudes, subjective norms, perceived behavioral control and intention) and within the environmental part of the model (palatability, portion size, type of food choice=special dish, not type of food choice=salad bar) remain significant, this does not hold for the interaction between both parts of the model. In fact, we observe that the link between palatability and attitude, and even more important between behavioral intention and leftover behavior diminishes in size and becomes insignificant (see Figure 4). Solely the impact of perceived portion size on perceived

behavioral control remains significant although it also decreases in magnitude from -0.359 in the general model to -0.280 in the grouped model under time pressure. Finally, for participants under time pressure, a differentiation of gender becomes a significant determinant for leftover behavior (standardized impact of being male is -0.221 (see Figure 4). Remarkably the R^2 values for intention and behavior are both improved compared to the general model.

Figure 4. Estimation results for group with short lunch time (N=105)



Standardized estimates (only significant at α=*0.1, **0.05, ***0.01)

Overall, the grouped model supports the hypothesis that in the case of time pressure, leftover behavior becomes dominated by environmental factors and is less influenced by behavioral determinants **(H10b)**.

V Discussion

At a general level, our model supports the relevance of behavioral, social and environmental determinants in explaining plate leftovers in a university canteen setting.

Reviewing the behavioral determinants in the model, the classical TPB components of behavioral intention are supported in our analysis, as is the impact of intention on observed food leftover behavior. This extends findings on the successful application of this theory for

the consumption of takeaway foods (Mahon et al., 2006), as well as the purchase of organic (Tarkiainen & Sundqvist, 2005) and genetically modified food (Cook et al., 2002). An extension of the TPB by personal norms as suggested by Aertsens et al. (2009) and by Arvola et al. (2008), however, could not be substantiated by our results. In contrast to the studies on organic foods by Aertsens et al. (2009) and Arvola et al. (2008) it was not possible to distinguish personal norms from other behavioral constructs with our dataset. Thereby our study indicates the close interrelation between personal norms on the one hand and attitude, subjective norms, perceived behavioral control and intention on the other hand. Thus, one might conclude that the dimension of personal norms is with respect to plate leftover behavior implicitly considered by those other behavioral constructs (Ajzen & Fishbein, 2005; Arvola et al., 2008).

Regarding the relevance of social influences on food-related behavior, our model confirms the significant impact of subjective norms on students' intention to prevent plate leftovers. Thereby, the relevance of descriptive and injunctive social norms as highlighted in the past for fruit and vegetable consumption (Thompson, Bachman, Baranowski, & Cullen, 2007), for the choice of healthy versus unhealthy food in university cafeterias (Mollen et al., 2013), as well as for the amount of food that female students consume at a meal (Hermans et al., 2012) is supported. On the other hand, the presence of others as situational social influence which has been suggested to determine the amount of food chosen and consumed in comparable settings (Young et al., 2009) did not have any significant impact in our model. An explanation for this non-significance may be that most of our participants did eat with more than one other persons and that the university cafeteria in general is very full during lunchtime. This changes the meaning of the question 'whether a person had lunch on his/her own' towards the question 'whether a person had lunch sitting next to people he/she is familiar with or not'. Although Clendenen, Herman, & Polivy (1994) state that "the relationship of dining companions is an important factor contributing to social facilitation" (p.1), they also conclude that this

relationship only moderates a general impact on food consumption by the presence of other people.

Most environmental determinants of the derived theoretical framework have been supported empirically. Moreover, our empirical models confirm the interplay of personal and environmental factors that influence university students' food leftover behavior. First, our findings support the relevance of perceived portion size and taste for plate leftovers as found in other studies (Betz et al., 2015). Freedman et al. (2012) show that (objectively) smaller portion sizes lead to lower levels of plate waste. Our results for portion size are in line with these findings assuming a correlation between larger portion sizes and plate leftovers. However, since we only consider the individually perceived portion size, our results may be biased compared to objective portion size measurements. Past research indicates that the perception of portion sizes does not necessarily align to objective portion size measurement (Diliberti, Bordi, Conklin, Roe, & Rolls, 2004; Wansink, Painter, & North, 2005; Wansink & Van Ittersum, 2013). Regarding the link between the different types of food choice (e.g. salad bar vs. regular service line) on the one hand and palatability as well as food leftovers on the other hand two differentiations - special dishes versus regular component-based dishes and food from the salad bar versus food from the regular service line - proved to be significant. Notably, we found that special dishes positively influence the palatability rating thereby indirectly reducing plate leftover. However, special dishes also directly increase plate leftovers. Since, there was no significant impact of special dish on portion size we can rule this factor out as explanation for the increase in leftovers. Potentially, the choice of a special dish may be related to its irregular presence in the lunch menu of the cafeteria and related perceptions from consumers. However, no study could be found that has analyzed effects of this kind yet. Comparisons may be drawn from studies indicating that descriptive names of lunch options positively influence the perception of regular and new food options (Morizet, Depezay, Combris, Picard, & Giboreau, 2012; Wansink, van Ittersum, & Painter, 2005). The

impact of time as environmental factor was analyzed (a) as direct determinant of leftovers and (b) as conditional factor for relationships between other structural constructs. Regarding the former we could not find a link between time pressure and food leftovers in our aggregate model. In this respect our model contradict findings for company canteens by Finkbeiner (2013) and for school cafeterias by WRAP (2011). Regarding the latter, our estimation results of the grouped model support notions that human behavior under time pressure becomes more dominated by environmental factors and related automatic cues instead of behavioral rational considerations such as behavioral intention (Evans, 2008). Our estimates moreover show that females generally tend to have more plate leftovers than males and that -based on automatic and environmental influences under time pressure- this tendency becomes stronger. This is in line with general tendencies of female students to apply habitual plate clearing less frequently than male students (Robinson & Hardman, 2015). Overall, the grouped estimation also reveals that under time pressure, leftovers are stronger related to environmental factors and more independent from stated behavioral intention, leading also to almost separate model of behavioral determinants on the one hand and environmental determinants on the other.

V.1 Limitations and Future Research

In interpreting the results of this study, a number of limitations need consideration. First, the order of the data acquisition is not in line with the TPB framework. As described in section III.2, individual plate leftovers were first observed and documented and subsequently students took part in the online survey. This was not only a more convenient order of data collection but also considered reasonable as a reversed order and thus a questionnaire on food leftovers directly before measuring food leftovers would likely have biased participants behavior. Nevertheless, this implies that behavioral intention is measured after the actual behavior. A tripartite data collection with a survey on intentional constructs, an observation of behavior regarding food leftovers well after the first survey and a second survey regarding situational

factors at the day of observation would be optimal but hardly realizable. Given that behavioral constructs are considered as relative stable over time the chosen design seems justified.

Second, the sample is a convenience sample comprised exclusively of students. This suggests that future research should include a more diverse sample as it can be expected that the level and determinants of consumers' leftover behavior differ according to socio-demographics such as age, income and education.

Moreover, we applied potential influences of the most recent lunchtime experience of participants on behavioral constructs by considering relationships between palatability and attitudes as well as between portion size and PBC.

Fourth, personal norms could not be distinguished from other behavioral determinants, indicating that personal norms may be incorporated in other components of our model. Nevertheless, future research may investigate whether a different measurement system of personal norms or alternative related constructs such as self-image are of relevance for consumers' food leftover behavior.

Finally, we would like to address this latter aspect as one additional limitation. The share of explained variance in behavioral intention is 45% and in leftover behavior is 20%. Although those values, according to a meta-analytic review by Armitage & Conner (2001), are in line with other TPB applications , they indicate that a relevant proportion of behavior cannot be captured by the considered behavioral and situational model components.

In order to overcome the named limitations, we suggest to conduct data collections over longer time periods and potentially also repeatedly for participating individuals. This may provide better insights in how environmental and situational determinants interact in different potential combinations. Presumably, this may also improve the performance of our model in explaining variation of leftover behaviors.

VI Conclusion

With the aim of deriving and testing a model which determines individual food leftover behavior in a cafeteria setting, we jointly considered environmental, social and behavioral determinants that have been stated to influence different food-related behaviors in the past. Our estimation results for a sample of 343 students during three days at a university canteen provide relevant findings with respect to the importance and interaction of stated personal/behavioral, social and environmental/situational determinants and link them to observed behavior. We find evidence for a general significant impact of behavioral intention on leftover behavior and for the composition of intention by attitudes, subjective norms and perceived behavioral control. This supports past research on the application of the TPB for food-related behaviors such as organic food purchasing (Arvola et al., 2008) and healthy food consumption habits and waste-related behavior (Sparks et al., 1992). Complementary, we also find evidence for the relevance of environmental/situational determinants, namely portion sizes, palatability and specific types of food choice which is supporting a different set of past studies that focus on situational impacts on food consumption (e.g. Marjorie R Freedman & Brochado, 2010; Wansink & Van Ittersum, 2013). With respect to the impact of social determinants, our findings support the relevance of subjective norms for behavioral intention although this impact is relatively weaker than the impact of attitudes and perceived behavioral control. The additional consideration of the presence of other persons as a social context variable could not be supported in its impact on leftover behavior. Importantly, we moreover find that environmental/situational and behavioral/personal determinants are interrelated and that the relevance of determinants is relative to time constraints. This stands in line with studies that generally state a shift from deliberate to spontaneous decision making of individuals under time pressure and hence a stronger reliance on situational and environmental factors. Overall, the structural model reaches a sufficient R^2 for behavioral intention and observed leftover behavior. It may be interesting to apply this model other

settings different from a university canteen and to furthermore conduct extended data collections since the interplay of variable situational and more constant personal determinants may benefit from analyses over more than one point in time. Besides it may be worth reformulating and extending the inclusion of personal norms and social context in the model as both have been regarded relevant determinants of comparable food-related and sustainable behaviors in other studies. As a final remark and in line with the general aim of providing insights to decrease avoidable food waste in form of plate leftovers by our research, our results show that food leftovers are determined by a complex set of interrelated factors. Hence we may assume that simple measures to decrease avoidable food waste may take effects via complex behavioral structures. In order to understand and support changes in food waste behaviors we suggest to also analyze changes within the behavioral model coming from focused interventions such as adapted portion sizes or information campaigns.

VII Literature

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VIII Appendix

VIII.1 Appendix 1. Results of the Confirmatory Factor Analysis

Standardized Factor Loadings			Sum of Squared Loadings	Squared Sum of Loadings	Sum of Residual Variances	**Composite Reliability**	**AVE**	Square Root AVE	maximum correlation in model	with construct
Having leftovers is bad/good	**Attitudes**	0,765	1,617	4,818	0,805	**0,857**	**0,654**	0,808	0,522	Intention
Having leftovers makes me feel satisfied/unsatisfied		0,646								
Having leftovers makes me feel happy / unhappy		0,784								
Others finish all food on their plate x I try to do the same	**Subjective Norms**	0,573	1,294	3,775	1,057	**0,781**	**0,623**	0,790	0,420	Intention
Others think people should finish all food x their opinion is important to me		0,569								
Others may critcize me if I don't finish all food x this makes me feel uncomfortable		0,801								
I will do my best to empty my plate	**Intention**	0,653	1,094	2,161	1,530	**0,585**	**0,651**	0,807	0,522	Attitudes
I generally try not to leave food		0,817								
Predicting food amount at food choice is easy	**PBC**	0,495	1,487	4,145	0,964	**0,811**	**0,647**	0,804	0,491	Intention
Finishing is usually easy to me		0,936								
I could always finish all food on my plate if I wanted to		0,605								
Visual appearance	**Taste**	0,604	1,624	4,800	0,809	**0,856**	**0,655**	0,809	0,258	Intention
Taste		0,783								
Smell		0,804								

VIII.2 Appendix 2. Descriptive properties of indicators

Variable	Mean	Standard Deviation	Minimum	Maximum	Skewness	Kurtosis
I will do my best to empty my plate	4.18	1.04	1.00	5.00	-1.22	0.70
I generally try not to leave food	4.29	1.00	1.00	5.00	-1.58	2.07
Having leftovers is good/bad	5.21	1.15	1.00	7.00	-0.61	1.14
Having leftovers makes me feel satisfied/unsatisfied	5.21	1.37	1.00	7.00	-0.57	0.41
Having leftovers makes me feel happy/unhappy	4.94	1.12	1.00	7.00	0.22	0.63
Others finish all food on their plate x I try to do the same	10.84	5.95	1.00	25.00	0.46	-0.57
Others think people should finish all food x their opinion is important to me	14.33	5.24	1.00	25.00	-0.19	0.12
Others may critcize me if I don't finish all food x this makes me feel uncomfortable	6.06	4.40	1.00	25.00	1.49	2.84
Predicting food amount at food choice is easy	4.21	1.01	1.00	5.00	-1.38	1.23
Finishing is usually easy to me	3.79	1.32	1.00	5.00	-0.78	-0.74
I could always finish all food on my plate if I wanted to	3.94	1.04	1.00	5.00	-0.90	-0.03
Visual appearance	3.36	0.94	1.00	5.00	-0.23	-0.38
Taste	3.59	0.91	1.00	5.00	-0.54	0.19
Smell	3.52	0.84	1.00	5.00	-0.27	0.02